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CARNIVOROUS PLANT NEWSLETTER

Journal of the International Carnivorous Plant Society

Volume 36, No. 2 June 2007

CARNIVOROUS PLANT NEWSLETTER

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Front Cover: The new cultivar *Sarracenia* 'Suspicion'. See article on page 53. Photograph by Aidan Selwyn.

Back cover: *Pinguicula crystallina*. *Flora Graeca*, vol. 1, tab. 11 (London 1806). Coloured engraving based on a sketch drawn by Ferdinand Bauer. See article on page 38. Illustration: Photolabor Universität Göttingen.

Carnivorous Plant Newsletter is dedicated to spreading knowledge and news related to carnivorous plants. Reader contributions are essential for this mission to be successful. Do not hesitate to contact the editors with information about your plants, conservation projects, field trips, or noteworthy events. Contributors should review the "Instructions to Authors" printed in the March issue of each year. Advertisers should contact the editors.Views expressed in this publication are those of the authors, not the editorial staff.

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Contents

Seedbank ----- 35
Some Background on the CPN Scanning Project ----- 36
Looking Back: CPN 25 years ago ----- 36
1806, year of birth of the "cruel" *Pinguicula crystallina* Sm. (Lentibulariaceae) ----- 38
Conference Announcements ----- 45
Utricularia Containment: Trying to Prevent the Great Escape ----- 46
Literature Reviews ----- 49
New Cultivars ----- 53
Prey preference in two species of North American bladderworts (*Utricularia*) suitable for water gardens ----- 57
Book Review ----- 62
News and Views ----- 63

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Donate seed and get credit for free seed from the seed bank. Seeds of selected varieties are available free to teachers for use in the classroom and to scientists and conservation organizations. It is ICPS policy not to sell internationally seed of plants protected by CITES Appendix I or the US Endangered Species Act.

John Brittnacher, Manager • john@carnivorousplants.org

Some Background on the CPN Scanning Project

Bob Ziemer, ICPS Board Member

You may be wondering, "Why did I get this CD with my June issue of Carnivorous Plant Newsletter?" It is the quiet but excellent culmination of several years of work involving contributions of many ICPS volunteers. It is part of a natural evolution for Carnivorous Plant Newsletter, an evolution that has been ongoing since its inception in 1972. For the first two decades, the ICPS's products were strictly non-electronic.

That started to change in November 15, 1994, the birth date for the CP Homepage managed by Rick Walker. Rick has an online history documenting his web site's development, which includes the CP Database, CP listserv, and the CP Trading Post.

In 1998, the ICPS web site became established, and in February 2000, a few sample articles from Carnivorous Plant Newsletter were posted.

Meanwhile, the stacks of old (and sometimes rotting!) issues of Carnivorous Plant Newsletter were becoming more expensive to maintain in storage. Throughout 2002, the ICPS advertised the clearance sale of all these back issues. The back issue sale concluded in December 2002, after which issues were no longer available. However, at that time the ICPS had started to explore the possibility that complete back issue sets might be made available on CD ROM.

Since Carnivorous Plant Newsletter is a publication venue for new Latin plant name descriptions, it was important that these new species descriptions were available to a wider audience than only the ICPS membership. Furthermore, because of the work of Jan Schlauer, the ICPS was selected as the CP International Registration Authority for cultivar names; this made it even more important that select articles appearing in Carnivorous Plant Newsletter be made more widely available. Consequently, these key articles were added to the ICPS web site under Species Descriptions and Cultivar Registrations.

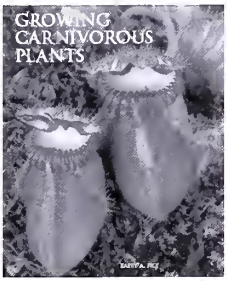
These steps increased the desire to convert back issues of Carnivorous Plant Newsletter into electronic format. In June 2004, ICPS President Carl Mazur requested volunteers to help scan back issues of the journal. Between July and October 2004, David Conner scanned most of the 4,000 pages and sent the images on CD to Carl. From October 2004 to September 2006, Carl worked on the tedious task of cropping images and converting them to PDF. There were many delays as some of the pages had to be rescanned and the hard-copy of some issues had to be found.

In September 2006, Carl passed the job of completing the project to Bob Ziemer. Some of the pages needed to be reprocessed and several volumes still needed to be scanned. Bob and David Conner reviewed each of the pages and replaced those that were found to be defective. The quality of the scanned images may vary, but we strived for the best that we could achieve given the amount of work and time, and the quality of the available hard copies of the back issues.

By the end of December 2006, the project was completed and Carnivorous Plant Newsletter volumes 1 (April 1972) through 35 (December 2006) were written in PDF format to CD for duplication and distribution. And now you have in your hands a remarkable product: thirty-five years of Carnivorous Plant Newsletter! Enjoy!

Looking Back: CPN 25 years ago

Editor Don Schnell published one of his very important photographic primers, this one on variants of *Sarracenia rubra*: "This has been the most difficult of the primers to present in our space limitation because here in *Sarracenia rubra* the differences felt to be present are based more on degree of a character manifestation than on a simple presence/absence factor as has been the case with most of the variants in the preceding two primers." Indeed! This is a tricky group of plants, and reviews like Don's back in 1982 were extremely useful. Now, of course, you have the entire review on the disk included with this issue!



Growing Carnivorous Plants (the book)

Yes, you can get copies from the publisher or Amazon.com, but buy your copy directly from the author, Barry Rice, and he will sign it for you! Very cool, indeed!

Instructions at http://www.sarracenia.com/cp.html, or send a check (payable to "Barry Rice" in US$) to: P.O. Box 72741, Davis CA 95617, USA. Total cost: US$47.95 within the USA. International customers–refer to the web site.

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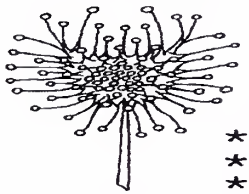

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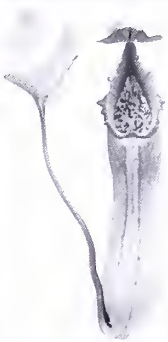

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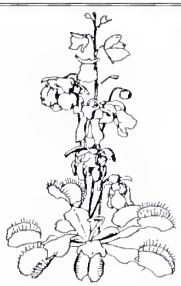

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1806, YEAR OF BIRTH OF THE "CRUEL" *PINGUICULA CRYSTALLINA* SM. (LENTIBULARIACEAE)

TO THE MEMORY OF 200 YEARS *FLORAE GRAECAE PRODROMUS* (1806-1816) AND *FLORA GRAECA* (1806-1840)

S. JOST CASPER • Biberweg 8 • D-07749 Jena • Germany • jost.casper@arcor.de

Keywords: History: *Pinguicula crystallina*.

Introduction

Since its discovery, *Pinguicula crystallina* Sm. has deeply impressed botanists and friends of flowering plants at every turn. It was discovered in 1787 by John Sibthorp and Ferdinand Bauer in the Troodos mountains of Cyprus, but this tiny carnivorous herb first became known to the scientific botanical community in 1806, with the publications of the famous *Florae Graecae Prodromus* and *Flora Graeca*. In 1914, Holmboe (p. 216) called it "the most typical species and also the greatest ornament of the vegetation in the springs."

The rare and tiny violet-like rosulate plant has enchanted the eyes of all plant hunters who have seen it. Indeed, its scientific name *crystallina* was chosen of because of "the clear drops on the leaves glittering like diamonds in the sunshine." Nowadays, strongly endangered by various human activities such as the building of streets and aquaducts[1], it dwells in small populations in two restricted areas in the Cypriotic Troodos mountain range, in gorges deeply cut into the hills by rivulets and at waterfalls.

For several years, the English writer Valerie Sinclair, resident in Paphos, has explored and observed the Cypriotic countryside and its floral treasures. She published a comprehensive book on the flora of the island for nature lovers. Its distinctive charm are its poems that sing the praises of beautiful or extraordinary species. Inspite of the delicacy of butterworts, she seemed to be frightened by their hidden aggressive "cruel" insectivorous behaviour and was inspired to write the following (Sinclair 1992:107):

Butterwort

On Troodos mount in ambush lies
This cruel plant with violet eyes.
Innocent insects, gathering round
Seductive blooms in marshy ground.
Alight upon adhesive leaves,
To find—too late—how sight deceives.
Carnivorous Butterwort, thou wert meant
For loitering with foul intent.

The *Flora Graeca* project

The botanical exploration of the eastern part of the Mediterranean, its countries and islands, has long been very active. The works of Dioskorides (1. cent. p. Chr.), were for centuries a kind of Bible for physicians, pharmacologists, naturalists, and philologists. Since the area was under the political power of the Ottoman Empire and the Venetian Republic, research was restricted. Merchants, diplomats, pilgrims, and both professional and amateur travellers were prohibited from visiting the region.

[1]Monasteries were supplied with spring water by aquaducts; cf. Unger & Kotschy (1865:499).

In spite of these prohibitions, great efforts were made to obtain direct knowledge of the region.

One of the travellers was the English John Sibthorp (1758-1796), Doctor of Medicine and Elected Third Sherardian Professor of Botany at the University of Oxford. Walpole (1820: XII) notes that Sibthorp's "researches have greatly advanced our knowledge of the natural history of Greece, and of some islands of the Archipelago", i.e. the Aegean Sea including Cyprus. From 1784 to 1787 and from 1794 to 1795, Sibthorp and his companions undertook two long-lasting expeditions into the "Levant" (as the territory was then called).

The most important results of Sibthorp's explorations were laid down in the two volumes of *Florae Graecae Prodromus* (1806-1816) and in the ten volumes of the magnificent *Flora Graeca* (*Sibthorpiana*) (1806-1840), which were planned by Sibthorp and edited after his death[2] by James Edward Smith (1759-1828)[3] and John Lindley (1799-1865)[4]. The work is distinguished not only by the great number of plant species new to science (approximately 2,800) but above all by the excellent illustrations based on the pencil sketches and water colours of his apt draughtsman Ferdinand Bauer[5].

Flora Graeca is a very rare book (see Figure 1). Only about thirty copies were originally printed. Between 1845 and 1847, the publisher Henry Bohn, London, arranged a reissue of forty copies[6]. The work was virtually inaccessible for most European botanists (Stearn 1967:176). Moreover, nearly all copies in our scientific libraries are mixtures of the original and the new edition. That is so with the copy at the Niedersächsische Staats—und Universitätsbibliothek Göttingen that I have studied.

In 1799 Smith started his laborious work of editing the *Prodromus* and the *Flora*. He had at his hands all the materials available at Oxford: Sibthorp's specimens (unmounted and without annotations)[7], Bauer's pencil outline drawings (some with locality data, but without scientific or collector's names), Bauer's watercolours (not annotated), Sibthorp's diaries and field notes (containing many scientific names, locality data, but no descriptions) and Sibthorp's incomplete manuscript for the *Prodromus* (without descriptions).

Smith (1816) wrote that he had Sibthorp's outline for the *Prodromus*, but for the *Flora* only the figures had been prepared, "nor any botanical characters or descriptions whatever...The final

---

[2]John Sibthorp had made his life's work the study of the plants of Dioskorides in their natural habitat (after having studied the Dioskorides manuscript at Vienna) and their identification with the species living today. In March 1786, to realize this plan, he journeyed to Crete with the Austrian draughtsman Ferdinand Bauer, and then stayed for an even longer time in Cyprus. He visited Asia Minor, Athos and Athens and returned in 1787 to Oxford. In 1794-1795 he revisited—without Bauer—the Aegean Sea and the Peloponnesus. On his return he caught a deadly illness and died at the beginning of 1796, before completing his opus magnum.

[3]Sir James Edward Smith, English botanist, the first president of the Linnean Society London, edited between 1806 and 1816 the two volumes of *Florae Graecae Prodromus* and between 1806 and 1830 volumes 1-7(1) of *Flora Graeca*.

[4]John Lindley, English botanist, founder and for forty years secretary of the Royal Botanical Society. After the death of J. E. Smith, Lindley produced volumes 7(2)-10 of *Flora Graeca* within about 10 years (completed in 1840). See Stearn 1967:170).

[5]Ferdinand Bauer (1760-1826), Austrian landscape- and animal-painter, accompanied Sibthorp on his first trip to Greece during 1786 to 1787. He brought home a great many sketches of landscapes, animals, and plants, the latter the basis of the plant illustrations of *Flora Graeca*. These illustrations were subsequently engraved by James Sowerby, his sons and collaborators. It is said that in the first volumes the illustrations were coloured by Bauer (Bauer left England in 1814 and returned to Vienna) and Sowerby. These illustrations represent "the Non plus ultra of accuracy, botanical reliability and artistic beauty" ("das Non plus ultra an Genauigkeit, botanischer Zuverlässigkeit und artistischer Schönheit"; Nissen 1966:117).

[6]The new edition is equivalent to the first, and is only distinguishable by the water mark.

[7]The question whether Bauer collected herbarium material during the journey in the Levant has been discussed by various botanists. Kotschy was convinced that he did (Unger & Kotschy 1865:295). Smith seemed to be of the same opinion, because he wrote in the paragraph on *Pinguicula* (in Rees 1814: 482) "gathered by Dr. Sibthorp and Mr. Ferdinand Bauer, in watery places near Comandria, in the isle of Cyprus." But Lack & Mabberley (1999:182) have found no evidence that he did, apart from the allusive note 'D. Ferd. Bauer' following several entries in the *Prodromus* (in the case of *P. crystallina* the *Prodromus* has 'D. F. Bauer', the *Flora* 'D. Ferd. Bauer').

determination of the species, the distinctions of such as were new, and all critical remarks, have fallen to the lot of the editor" (i.e. to Smith). Smith had already explained the background of the whole *Flora Graeca*, in the introduction to the first instalment of the *Prodromus* (1806), that "in both works the botanical observations, the specific characters and the descriptions are all to be attributed to me: for Sibthorp left all these untouched" (here I use the translation of the Latin text by Lack & Mabberley, 1999:200).

Lack & Mabberley (1999:226) clearly pointed out: "*Flora Graeca*, one of the most sumptuous botanical works ever published and in the quality of its illustrations surpassed by few...was universally praised by commentators." "The accuracy of Bauer's botanical drawings in both form and colour has been universally praised" (Lack & Mabberley 1999:109). Smith and Lack analysing Bauer's work in detail did not find more than very minor mistakes. However, all the leading experts who studied the *Flora Aegaea* "were puzzled by the discrepancies between the precision of the illustrations painted by Bauer and the confused nature of the locality data by Sibthorp, who had not correlated his specimens and drawings with his field notes" (Lack & Mabberley 199:227). Objectively we must conclude that the famous work, undoubtly a "Markstein" in the history of descriptive botany, is the result of the effort of many persons, and especially of two—the excellent draughtsman Ferdinand Bauer and the skillful and versatile botanist James Edward Smith—who with immense engagement fulfilled "their master's (i.e. Sibthorp's) will".

The detection of the "cruel" *Pinguicula crystallina*

With respect to our *Pinguicula* we learn from Sibthorp's diary of his first journey that the four-person-party —J. Sibthorp, F. Bauer, J. Hawkins[8], and N. Imrie[9]—travelled across Cyprus for five weeks from about early April to mid May 1787.

On May 1st 1787, the group descended from the summit of the Troodos mountain range (Khionistra) northwards, entering the Val of Soulea (Xeropotamos; cf. Unger & Kotschy 1865). Sibthorp's translation by Lack & Mabberley (1995:62)[10] reads, "on this day...in the diary the names of two small rosette plants discovered 'in a little morass in the vale... The stay of my Draughtsman to sketch these plants was the cause of my losing my Companions' " (i.e. Hawkins, Imrie) (MS Sherard 247, f. 13r (OXF)). The draughtsman was, of course, Bauer. Sibthorp continued that one of these plants is named "*Pinguicula villosa*, certainly referring to *P. crystallina* Sm. Bauer very carefully studied the slimy leaf surface of this tiny insectivorous plant, noting 'Wasertropfen' (sic!) (water drops) on his pencil sketch."

This passage contradicts some of the details given by Walpole (1820:23) from "the papers of the late Dr. Sibthorp," in which Sibthorp recalls his travels in Val of Soulea: "In a little morass, in passing through the vale, I had picked up the *Lobelia setacea* [= *Solenopsis minuta*; cf. Meikle 1985:1244] and *Pinguicula crystallina*. My draughtsman stopping to sketch these plants was the cause of my losing my companions, who slept at a neighbouring monastery."

Lack & Mabberley (1999:31) confirmed that Walpole had the Sibthorp diaries on loan from Oxford and had been in contact with J. Hawkins and J.E. Smith. When Walpole edited "the papers of the late Dr. Sibthorp" he often substantially shortened the texts producing a kind of patchwork, and in the case of our *Pinguicula* he seems to have replaced Sibthorp's original epithet *villosa* by the (in the eyes of Sibthorp's successors correct) epithet *crystallina* given by Smith in *Florae Graecae Prodromus 1* (1806:11). But, he didn't inform the reader about his change of the nomina.

From the *Prodromus* we learn by the allusive note "D.F. Bauer" following the entry of

[8]John Hawkins (1761-1841), friend and companion of Sibthorp. He was strongly interested in natural sciences, especially in earth science (mineralogist). First research journey 1784-1788 (February 1787 to August 1787 together with Sibthorp in Cyprus) and second one 1793-1798 (1794-1795 with Sibthorp in Zákinthos and Morea). In 1799, he arranged the publication of *Florae Graecae Prodromus* and *Flora Graeca*.

[9]Ninian Imrie (?-1820), "Scottish gentleman geologist", elected Fellow of the Royal Society of Edinburgh, accompanied Sibthorp on his tour from Istanbul to Patras (March to September 1787).

[10]I am much indebted to the excellent, profound, and meticulous *Flora Graeca* Story by H. Walter Lack (1999; with D.J. Mabberley), that sheds some light on the dark caused by the manyfold mistakes, errors and inconsistencies that are found in literature on Sibthorp's opus magnum.

Figure 1: Frontispiece to *Flora Graeca*, vol.1 (London 1806); a coloured engraving based on a drawing by Ferdinand Bauer (altered at the suggestion of J.E. Smith). The plants arranged around an oval are (in a clockwise direction) — top: *Gladiolus triphyllus*, *Salvia pomifera*, *Salvia lanigera*; — bottom: *Panicum teneriffae*, *Veronica gentianoides*, *Cyperus fuscus*, *Fedia cornucopiae*, *Morina persica*, *Salvia lanigera*, *Gynandriris sisyrinchium*. Within the oval (left down) the title written by [N.] Tomkin [Scripsit] and (right down) the signum of the engraver Halliwell & Co [Sculp] (cf. Lack 1997:625,627). —Photocopy: Photolabor Universität Göttingen.

Pinguicula crystallina that Bauer had apparently collected the plant! However, Kotschy (in Unger & Kotschy 1865:295) and Holmboe (1914:167) ascribe the collection of our *Pinguicula* "an Quellen von Evrico" (i.e., around springs of Evrico) to Sibthorp and that of "Comanderia" to Bauer. The (relatively poor) type label of *Pinguicula crystallina* has the handwritten phrase "*Pinguicula crystallina* Sibth." without any additional note (Casper 1970:279, Abb. 3; photocopy). So it is perhaps unclear if Bauer or Sibthorp collected the type specimen of *Pinguicula crystallina.*

The "iconotype" of *Pinguicula crystallina* (*Flora Graeca* 1:8, tab. 11)

Bauer prepared pencil sketches of many plants in the field, from live specimens, during Sibthorp's first journey (Lack & Mabberley 1999: 108, 231). He used a code for recording the colours of the plants he sketched, and the sketches are surrounded by what Lack & Mabberley (1999) evocatively call "clouds of numbers" that refer to the various colours of his code. This method of recording colours was in response to the hurry in which the expedition took place, yet was effective in producing accurate water colours later when more time was available. Bound in one volume, Bauer's pencil outline drawings are preserved sub MS Sherard 247 (OXF; following Lack & Mabberley 1999:108).[11] *Pinguicula crystallina* is found on folio 13r with the annotations "Cybrus" and "Wasertropfen" (sic!) by Bauer but without a scientific name. In addition to a sketch of the habit of the plant, are accurate drawings of "*calyx, corolla pictoris opo expansa, labium superius magnitudine auctum, stamina et pistillum and pistillum scorsim*" (see *Flora Graeca* 1:8, tab. 11).

The *Pinguicula crystallina* water colour (see Back Cover) prepared by Bauer for the *Flora Graeca* is kept in the Department of Plant Sciences, University of Oxford, sub MS Sherard 244 f. 96 (OXF; following Lack & Mabberley 1999:250). Smith annotated the illustration in pencil "11" (individual number cited in the *Prodromus* and the *Flora*), "38" (the number of the respective species entry in the Prodromus), and "*Pinguicula crystallina*". Bauer usually signed finished water colours "Ferd. Bauer del", but no annotation by Bauer of any kind is on the work, suggesting the water colour was unfinished.

I have mentioned that the engravings on copper of Bauer's drawings were executed by James Sowerby[12] and his company. Sowerby's job was difficult and laborious. Many of Bauer's water colours had been left unfinished; the pencil outline drawings had been only partly coloured. But it was Sibthorp's express will that his opus magnum should be a coloured one. In all his work, Sowerby followed Bauer meticulously, and the result was a set of 966 folio engraved and coloured plates, comprising 28,980 individual figures. Lack & Mabberley (1999:231) concluded that "Sowerby, his sons, and their collaborators did a marvellous job, equal in quality to the work of that extraordinary plant illustrator, Ferdinand Bauer."

Taylor (in Meikle 1985:1244) pointed out that the plant shown on plate 11 of *Flora Graeca* 1 (1806) is "uncharacteristic of Cyprus material of *Pinguicula crystallina*." The term uncharacteristic refers to the feature "median lobe of the lower corolla-lip...deeply bifid." Taylor, aware of Bauer's reputation as "normally the most accurate of draughtsmen" explains the (alleged) inaccuracy by supposing that "he may have had insufficient time to complete his sketch from fresh material." Indeed, Bauer was under great time pressure in the field—during the expedition they had to move quickly from one spot to another—as it is evident from Sibthorp's diary and Walpole's extract (see above). We can conclude that Bauer was stressed when he made his true-to-life sketch of our *Pinguicula.* His (unfinished) water colour elaborated in his studio in Oxford is not of the usual quality. But did he really fail? Having studied in 1994 our *Pinguicula* in its natural habitat in Cyprus and having compared it with a great many photographs taken by different professional and amateur plant lovers I must note that the variation of the feature "median corolla lobe rounded to emarginated" is enormous (see Figure 2). Admittedly, the "deeply bifid median corolla lobe" is, as I have seen, extremely rare.[13] Nevertheless, the water colour by Bauer must have induced Pantocsek (1874:75) to write wrongly [in *Pinguicula crystallina*:] that "*corollae labium inferius quadrilobum*", when discussing the relation of the Cypriotic taxon to his *P. laeta* [=*P. hirtiflora*] from Montenegro.

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[11]MS Sherard 237 (Lack & Mabberley 1999:108) is a misprint.

[12]James Sowerby (1757-1822), famous English painter and engraver; his *English Botany* (1790-1814) contains about 2,600 plates. Senior of the Sowerby company, a family business.

[13]It is unlikely that Bauer had in his hands such an aberrant specimen. Perhaps his true-to-life sketch was not clear enough.

Figure 2: *Pinguicula crystallina* corolla variation. The photographs show that the figures presented by Bauer in the *Flora Graeca* (1806:1, p. 8, tab. 11) as well those published by Taylor (1985:2, p. 2445, fig.1) are not really "typical". —on top: Cyprus, Caledonian Falls, S of Mt. Troodos, 1,360 m. 21/5/1980. Flowers white with yellow palate-like structure at throat; note the short corolla upper lip lobes and the purple nerves. —middle: Cyprus, Kakopetria, Ayios Nikolaos, 15.5.1996. Flowers with lilac-white-yellow corolla lower lip lobes. — Bottom: Cyprus, origin as in 1. Comparison of three white flowers in lateral, dorsal and ventral view; note the short corolla upper lip lobes, the broad corolla lower lip median lobe at apex not emarginate, the greenish-yellow tube and the short obtuse spur. Preparation and photographs: Jürg Steiger, Bern.

From the above discussion, we see that *Pinguicula crystallina* was detected on May 1, 1787 by J. Sibthorp and F. Bauer in the Cypriotic Troodos mountain range, collected (probably) and sketched at the *locus classicus* "Co(a)manderia"[14] by F. Bauer, and then nominated and described by J.E. Smith. The date of publication is November 1806 in the *Prodromus* as well as in the *Flora*.

The taxon[15] should be quoted as follows (cf. Taylor in Meikle 1985:1243; Lack & Mabberley 1999:199 — photocopy of pp.10—11 of the Prodromus, vol. 1; Lack & Mabberley 1999: 208 — photocopy of p. 8 of the *Flora*, vol. 1):

Pinguicula crystallina Sm. in Sibth. *et* Sm., *Florae Graecae Prodromus* 1:11 (1806); *Flora Graeca*.1:8; tab. 11 (1806).
Type: Cyprus: *In rivulis prope vicum Camandriae in insulâ Cypro. D. F(erd). Bauer (OXF).*

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[14]Co(a)mand(e)ria, region near Finike (Lack & Mabberley 1999:283).

[15]*Pinguicula crystallina* Sm. is said to be related to *Pinguicula hirtiflora* Ten. The nomen *Pinguicula crystallina* has priority over *P. hirtiflora*. If Tenore's taxon is regarded as conspecific with *Pinguicula crystallina*, it must be put into synonymy. Tenore's nomen was first published in 1811 (Casper 2006). His assertion that he would have observed his *Pinguicula* for the first time in 1806 in the kingdom of Naples has never been verified and has no nomenclatural consequences.

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It gives me great pleasure to announce that the 2008 International Carnivorous Plant Society Conference will be held in Sydney, Australia. The venue chosen is the Royal Botanic Gardens, in the heart of the city, close to many facilities. Since this is the first time this biennial conference has been held in the Southern Hemisphere it was deemed appropriate for it to be held at a time when the carnivorous plants across most of southern Australia would be at their best, and so the conference will be held from the 25nd to the 28th of September. The conference will include a number of lectures and demonstrations, and there will be some optional field trips to the Blue Mountains and Mt Tomah Botanic Gardens, both within 3 hours drive from Sydney. Provisions are also being made for a field trip to see *Cephalotus*, pygmy sundews and tuberous sundews in South Western Australia for conference attendees able to make it to this part of the country during their stay down under. Stay tuned for further details, and please mark the dates in your diaries; we'd love to see you in Sydney in 2008.

Greg Bourke

Utricularia Containment: Trying to Prevent the Great Escape

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Keywords: cultivation: *Utricularia.*

Introduction

Terrestrial and some epiphytic *Utricularia* species are easily grown on the tray system (D'Amato 1998; Slack 2000). The tray system is often preferred since it is space efficient, but the plants frequently send stolons out of the drainage holes in the pot and into the tray. These escaped stolons, if not corralled promptly, can then invade adjacent pots, which results in intermingling of species. This is disastrous for botanical collections where each pot contains a different strain or species of plant that needs to remain separate. In particularly bad cases, the roaming plant can completely overrun the plant in the invaded pot.

The most obvious solution for keeping different plants separate is to grow each one in a separate, undrained container. Unfortunately, this is not pragmatic since it means all the plants have to be hand watered or have a separate water emitter[1] which involves more facility resources (i.e. staff time or equipment) than is typically invested in *Utricularia* collections. Automated watering systems, unless equipped with a water-level shutoff sensor, have the disadvantage that the water level will always inundate the undrained pot to the maximum level, which is not desirable for many species and also encourages the plants to spill over the top of the pots.

Another possible variant would be to use undrained pots and then punch a hole in the side of the pot at the desired water level for each species. Alternatively, a drained pot could be placed in a shorter undrained pot. The pots could then be watered overhead by hand or automated irrigation and the excess water would drain out the hole on the side of the pot. Stolons escaping the pots would dry out on the greenhouse bench. Unfortunately, this approach still requires extensive hand watering or automated irrigation for each pot.

The purpose of this research was to determine if *Utricularia* could be grown on the tray system by containing the plants within the pots while allowing water to permeate into the pot. Both stainless steel screens (100 mesh) and glass fiber filters were evaluated as mechanisms to screen the drainage holes of the pots to contain the *Utriculatria* within the pot while allowing water to pass into the pot.

Materials and Methods

The experiment tested three containment conditions, namely no seal (control), stainless steel screen seal, and glass fiber filter seal. The stainless steel (316 type) screen was 100 mesh-size screen[2] (McMaster-Carr Supply Company, Los Angeles, CA) while the glass filters were GF type F filters (Whatman International Ltd., Maidstone, UK). The stainless steel screen was tough material that was unlikely to be damaged by the *Utricularia*, but it also has relatively large holes compared to the glass filter. In contrast, the glass filters had tiny pores, but the material was weak and may be pried apart by the stolons or damaged by handling. Plastic pots (10.2 cm or 4 inches) with four drainage holes were used for the treatments. Two types of pots were used during the experiment; the control and steel screen pots were vented on the sides while the glass filter pots were vented on the bottoms. The glass filters were difficult to seal on the side-vented pots,

[1]Using a separate emitter for each pot means that many of emitters would be required, and for a large number of plants the resulting rat's nest of tubing would be undesirable, especially for display collections where aesthetics are an important consideration.

[2]100 mesh screen has holes that are approximately 0.15 mm across.

which is the reason bottom-vented pots were used for this species. Waterproof silicone seal was used to seal the steel screens or glass filters over the drainage holes.

The three containment conditions were tested with eight species of commonly cultivated *Utricularia*: *Utricularia livida, U. sandersonii, U. dichotoma, U. praelonga, U. longifolia, U. nephrophylla, U. bisquamata*, and *U. calycifida*. Therefore, there were three pots for each species: one control, one stainless steel screen and one glass filter screened. For each species, a small cutting of equal sized was added to the three treatment pots. To reduce the chance of plants escaping over the top of the tops, the pots were filled to 2.5 cm below the rim with the soil mixture that consisted of 50% peat moss and 50% horticultural sand.

The plants were placed in a 21.25 × 10.75 cm trays, and a depth of approximately 2.5 cm of water was maintained in the trays for the duration of the experiment. The trays were maintained between 18-27°C (64-81°F) with a photoperiod of 14.5 hours, in the Botanical Conservatory greenhouses at the University of California, Davis.

The plants were grown for 9 months. Every month, the number of stolons that escaped out of each hole were counted for all the pots. Since the four holes in any given pot are pseudo-replicates of the pot, the data for each hole was recorded separately but then totaled for each pot. Any plant material that extended out of the pot was considered an "escape".

Results

The results (see Table 1) showed that glass fiber filters were the most successful in containing *Utricularia*, but even this treatment condition was not perfect. *Utricularia praelonga, U. longifolia* and *U. calycifida* still escaped from the pot by growing through the filter. Given enough time, I suspect that other species would also penetrate the filter. Unfortunately, the stolons pried open holes in the filter as they grow through the holes, thus the filter screening was damaged by the growth of the plant. In addition, the glass filters were more restrictive of water percolation into the pots. During the relatively dry and hot summer, a few of the pots with glass screens were considerably drier than the control or the steel screened pots.

The stainless steel screens proved more effective than the control pots in terms of containing *Utricularia*, but ultimately most species were able to escape the pots. Only *U. dichotoma, U. nephrophylla* and *U. sandersonii* failed to breach the screen, although the later two species also failed to escape from the control pots as well. The total number of escaped stolons in the steel-screen pots were considerably lower than the control pots and it took longer for the plants to escape from the pot. Stolons both grew through the screen as well as pried between the silicone seal and the pot. Therefore, the screening slowed but did not prevent the escape of *Utricularia*. In contrast to the glass filters, the steel screens were not affected by the plants and the silicone seal was still largely intact, so the pots could be re-used after dividing or transplanting the *Utricularia*.

The purpose of this experiment was determine how to grow *Utricularia* in a single tray without the species intermixing. The experiment focused on preventing stolons from escaping individual pots and entering the watering tray. However, the second part of this equation is that an escaped *Utricularia* species in the watering tray has to invade an adjacent pot by growing into the drainage holes. Once again, the stolon would have to grow through the screen to invade another pot. The screening, either glass filter or stainless steel screen, would also slow the invasion step. I suspect that this invasion step would be even slower than the escape step since the stolons in the tray would not be as root bound as the stolons in the pots. This gives the botanical curator more time to catch and repot the escaped *Utricularia* before the species are intermingled. There were no observed invasions during the course of this experiment.

The last point is that this experiment focused on vegetative growth as the mechanism by which the *Utricularia* spread. Unfortunately, some *Utricularia* species are infamous for their production and dispersal by seed. *Utricularia subulata* and *U. bisquamata* are two weedy species that often spread by seed. None of the treatments discussed here would be effective against seed dispersal. Therefore, I can only recommend that species that spread by seed dispersal should be physically far removed from the rest of the *Utricularia* collection, or even eliminated from the collection altogether.

Table 1. Number of stolons escaping the drainage holes for the three containment conditions (control, glass fiber filters and stainless steel screen) for each month of the experiment.

	Time (Months)								
	1	2	3	4	5	6	7	8	9
	Control (no screen)								
U. bisquamata	0	0	1	1	4	7	5	10	8
U. calycifida	0	0	1	1	1	0	1	0	3
U. dichotoma	0	0	0	1	1	1	3	2	2
U. livida	0	0	0	1	6	8	14	18	27
U. longifolia	0	0	0	2	7	10	13	18	20
U. nephrophylla	0	0	0	0	0	0	0	0	0
U. praelonga	0	0	1	4	4	5	3	5	7
U. saudersonii	0	0	0	0	0	0	0	0	0
Total # of escapes:	0	0	3	10	23	31	39	53	
	Glass filters								
U. bisquamata	0	0	0	0	0	0	0	0	0
U. calycifida	0	0	0	0	0	0	0	0	2
U. dichotoma	0	0	0	0	0	0	0	0	0
U. livida	0	0	0	0	0	0	0	0	0
U. longifolia	0	0	0	0	0	0	0	0	2
U. nephrophylla	0	0	0	0	0	0	0	0	0
U. praelonga	0	0	0	0	1	4	3	9	8
U. saudersonii	0	0	0	0	0	0	0	0	0
Total # of escapes:	0	0	0	0	1	4	3	9	12
	100 Mesh stainless steel screen								
U. bisquamata	0	0	0	0	1	4	4	3	3
U. calycifida	0	0	0	0	0	1	1	2	2
U. dichotoma	0	0	0	0	0	0	0	0	0
U. livida	0	0	0	0	0	0	1	0	0
U. longifolia	0	0	0	0	4	4	3	6	6
U. nephrophylla	0	0	0	0	0	0	0	0	0
U. praelonga	0	0	0	0	1	1	1	1	1
U. saudersonii	0	0	0	0	0	0	0	0	0
Total # of escapes:	0	0	0	0	2	10	10	10	12

Ultimately, the stainless steel screen appeared to be the best choice for *Utricularia* containment. Stainless steel screens are also available in finer mesh sizes, up to 400 mesh, with smaller holes that may be more effective at containment or invasion control without any added maintenance. In the end, none of the containment mechanisms were perfect. Therefore, vigilance is still required to prevent species intermingling on the tray system, but the frequency of maintenance would be lower if the *Utricularia* pots were screened.

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I would like to thank Tim Metcalf, Ernesto Sandoval and the Botanical Conservatory at the University of California, Davis for the space and resources to conduct this experiment.

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Literature Reviews

By Doug Darnowski, Barry Rice, Jans Schlauer, and guest reviewers.

Adam, J.H. & Hafiza, A.H. 2006. Pitcher Plants (*Nepenthes*) Recorded from Keningau-Kimanis Road in Sabah, Malaysia. International Journal of Botany 2: 431-436.

The authors continue confusion in the application of the name *Nepenthes curtisii* for a taxon (probably a relative of the true *N. stenophylla* of Masters, not in the sense of Danser) not including its type. *Nepenthes curtisii* is a straightforward synonym of *N. maxima* (as noted in numerous previous publications), and it is doubtful if its type specimen was really collected in Borneo as stated in the protologue (Curtis may have received the plants from Sulawesi/Celebes). A taxon formerly described as a subspecies of *N. curtisii* (but likewise rather a relative of *N. stenophylla*) is now considered an independent species, *N. zakriana*, by the authors. Another result of this paper, as dubious as the ones previously noted above, is the establishment of the new name *N. naquiyuddinii*. Those who always wanted to give a separate name to the specimens of *N. reinwardtiana* that lack "eye-spots" on the interior pitcher surface may now rejoice in referring to them with this new name. (JS)

Bohn, H. F., and Federle, W. 2004. Insect aquaplaning: *Nepenthes* pitcher plants capture prey with the peristome, a fully wettable water-lubricated anisotropic surface. Proc. of the Nat. Acadamy of Sciences USA, 101, 14138-14143.

The peristome (pitcher mouth) in *Nepenthes* species was previously thought to be a "safe" foothold for potential insect prey. In this paper, Bohn & Federle show that, only when moistened, does the peristome of *N. bicalcarata* become a slippery trap for ants that walk on it. Through a series of manipulative experiments, they showed that a lubricating film of water prevents attachment by the adhesive foot pads (arolia) of insects. Interestingly, ants which manage to climb out from the pitcher will have fluid retained on their bodies which, once they step on the peristome again, will rewet it and send them "aquaplaning" back into the pitcher. (Francis Brearley)

Casper, S.J. and Stimper, R. 2006. New and Revised Chromosome Numbers in *Pinguicula* (Lentibulariaceae). Haussknechtia 11: 3-8.

Together with confirmations of previously published counts, the following new counts are communicated:
2n=22: *P. agnata, P. crassifolia, P. cyclosecta, P. debbertiana, P. ehlersiae (previously reported as 32), P. emarginata, P. gigantea, P. heterophylla, P. jaumavensis, P. medusina, P. moctezumae, P. orchidioides, P. pilosa, P. primuliflora* (previously reported as 32), *P. rotundiflora, P. toldensis nom.nud.*
Other counts: *P. albida* (2n=16μ,18μ), *P. antarctica* (2n=16), *P. bissei* (2n=18), *P. bohemica* (32, published before but later revised to 64 and now confirmed as 32 again), *P. filifolia* (2n=18), *P. gracilis* (2n=20), *P. mariae nom.nud.* (2n=32), *P. poldinii* (2n=32), *P. sethos* (2n=44), *P. cf. vulgaris* (2n=32,64,128, previously only 2n=64 was known in this species). (JS)

Casper, S.J. 2006. Auf der Jagd nach *Pinguicula* in Albanien. ("Hunting for *Pinguicula* in Albania", in German) Haussknechtia 11:9-28.

Two taxa of *Pinguicula* are native to Albania, the widespread and fairly common *P. crystallina* subsp. *hirtiflora* (in the paper it is called *P. hirtiflora* or *P. louisii*, no formal decision is made which name should be preferred) and the rare *P. balcanica*. Several localities and their vegetation are described in this field trip report summarizing results of two expeditions in 2004 and 2005. (JS)

Casper, S.J. 2006. Birth, Burial, and Rebirth of *Pinguicula hirtiflora* Tenore (Lentibulariaceae)—a Reflection of the Making of Flora Napolitana (1811-1838). Haussknechtia 11:29-40.

The paper features in much detail the complicated processes of the composition of the treatise Flora Napolitana (a Flora of southern Italy) and of the ripening of the taxonomic concept of *Pinguicula hirtiflora* with the author of both. (JS)

Clarke, C. and Kruger, R. 2006. *Nepenthes tenax* C.Clarke and R.Kruger (Nepenthaceae), a new species from Cape York Peninsula, Queensland. Austrobaileya 7(2): 319-324.

Historically, as many as eleven species of *Nepenthes* species have been recognized in Australia, but Danser reduced all these to *N. mirabilis* in 1928. In 2005, Clarke & Kruger returned the Australian *N. rowanae* to full species status. In the current paper, the authors have identified a new species from flooded, and usually inaccessible peatlands of northern Australia. This new species is most remarkable for its small size—rosette pitchers are typically only up to 55 mm tall, aerial pitchers are typically 110-150 mm tall. The paper includes commentary on the plant's habitat, and relationships with closely related species such as *N. mirabilis* and *N. rowanae* (hybrids with both species are also noted). The authors report upon a dwarfed population of *N. tenax* (already a dwarfed entity!) that have the smallest aerial pitchers yet observed on *Nepenthes*—these are at most 5 cm tall! A key and line drawings are also provided. The specific epithet *tenax* means tenacious, and refers to the sturdy stems and pitchers, which are freestanding and resist wind.

When reading this paper, the question of course is whether *N. tenax* is a truly a separate species, or whether it is only a response of a population of *N. mirabilis* to unique conditions. However, the authors have enormous experience with the genus, so their opinions carry significant weight. (BR)

Conti, F. & Peruzzi, L. 2006. *Pinguicula* (Lentibulariaceae) in Central Italy: Taxonomic Study. Ann. Bot. Fennici 43: 321-337.

Recent research in Central Italy (mainly Abruzzo but also one site in Lazio) revealed differences between several populations that have previously been regarded a single taxon (*Pinguicula longifolia* subsp. *reichenbachiana*). *Pinguicula fiorii* from the Majella mountains was already segregated in 1987. This present publication establishes another new species in the complex, *P. vallisregiae* from the Camosciara mountains in the Abruzzo National Park. This is the same plant as featured under the provisional name *P. abruzzensis* by Jürg Steiger at the 1998 ICPS conference in Bonn. The presence of true *P. longifolia* subsp. *reichenbachiana* (type locality in SE France, close to the Italian border) in the region is denied. Previous reports of this taxon are referred to the species mentioned above or to *P. vulgaris*. Minor morphological differences between the different populations of *P. vulgaris* in Central Italy (the presence of this species there has been doubted by Jost Casper until recently) are considered sufficient to warrant subspecies distinction (*P. vulgaris* subsp. *anzalonei*, subsp. *ernica*, and subsp. *vestina* are described as new to science). If such practise was extrapolated to and throughout the vast circumboreal range of the species, hundreds or actually thousands of such subspecies could be described, but the taxonomic relevance of these entities appears doubtful. (JS)

Ellison A.M. 2006. Nutrient Limitation and Stoichiometry of Carnivorous Plants. Plant Biology 8: 740-747.

In this paper, Ellison presents a review of the history of the cost-benefit model for carnivory. In particular, he seeks to discuss any marginal benefit of carnivory with regard to the elements nitrogen, phosphorous, and potassium. Ellison's work on the ecology of carnivorous plants has, of late, usefully highlighted the fact that phosphorous may be as important as nitrogen, or more important, as a limiting nutrient, something seldom speculated in many books on carnivores—how many times do we see nitrogen pushed forward as *the* limiting factor in habitats frequented by carnivorous plants. Besides being a review, this is essentially a meta-analysis, pulling data from a large number of papers to evaluate the cost-benefit model, which predicts that carnivory has evolved as a means of coping with these low-nutrient habitats. His general conclusion is that, while useful and confirmed in some particulars, the cost-benefit model needs modification to allow for other factors such as evolutionary constraints on the evolution of carnivory in particular taxonomic groups. This is one more useful contribution from Ellison's lab, which has recently documented, among other things,

trapping of salamander larvae by *Sarracenia purpurea*. (DWD)

Lowrie, A. and Conran, G. 2006. *Drosera sidjamesii* (Droseraceae): Systematics and Ecology of a Natural Hybrid from Western Australia. Australian Systematic Botany 20: 44-53.

The new taxon described in this paper is the hybrid between *D. nitidula* subsp. *omissa sensu* Marchant & Lowrie, *non* Diels (an illegitimate name used for a taxon not including the type of the basionym, *D. omissa* Diels; no formal description was ever validly published for it, nor is an acceptable name available) and *D. pulchella* Lehm. The hybrid is intermediate in all major distinguishing features (incl. ecological preferences) between the two assumed parents, and the chromosome count (2n = 46) is the sum of the diploid counts of the parents (28 and 18, respectively): the hybrid is amphiploid. Frequently amphiploid hybrids are fertile while aneuploid hybrids, in which the chromosome count is the sum of their parents' different haploid counts, are frequently sterile. But in the present case fertility is rather weakly expressed, and most fruits fail to produce viable seed. (JS)

Parnell, J.A.N. 2005. An Account of the Lentibulariaceae of Thailand. Thai Forest Bulletin (Bot.) 33: 101-155.

The article is a local Flora account and essentially repeats known data (Taylor, 1989) with a few updates and notes. What really makes the article interesting is the description of an intriguing (for systematic rather than horticultural reasons) new species, *Utricularia jackii*. The type specimen has been seen and treated as something in need of further study by Taylor. But without fruits and seeds and on the basis of only a few specimens it was not formally described by him. Based on one further specimen (likewise without ripe capsules and seeds), the decisive step was now dared. At first sight *U. jackii* looks like a whole lot of other, yellow flowered species of sect. *Oligocista* (traps with two short appendages, "leaves" linear, 1-nerved, scales, bracts and bracteoles basifixed, pedicels dorsiventrally flattened, tricolporate pollen). What catches the eye (or rather, the microscope) is the occasional presence of small (0.4 mm across) white bulbils on the rhizoids. This feature is unique in *Oligocista* and actually makes the classification in this section doubtful. The author uses the presence of bulbils to differentiate *U. jackii* from the somewhat similar *U. vitellina* but it should be noted that the latter species has been rarely collected (never with fruits or seeds) and is not very well known. Taylor (1989: 404) writes: "Tubers are not present on the very sparse material of *U. vitellina* but they may well occur." If they occurred in *U. vitellina*, he would probably have placed this species in sect. *Chelidon* (that so far contains only the tuberous, West African *U. mannii*). Now there is at least a bulbiliferous *U. vitellina* relative. (JS)

Porembski, S. and Barthlott, W. (eds.) (2006) Special issue on carnivorous plants. Plant Biol. 8: 737-860.

The papers in this issue are adapted from presentations at a symposium organized by W. Barthlott and S. Porembski and held on the occasion of the XVII International Botanical Congress in Vienna in July 2005. Authors, topics and page ranges are as follows (JS):

Adamec, L.: Respiration and photosynthesis of bladders and leaves of aquatic *Utricularia* species. pp. 765-769.

Darnowski, D.W., Carroll, D.M., P∏achno, B., Kabanoff, E. and Cinnamon, E.: Evidence of protocarnivory in triggerplants (*Stylidium* spp.; Stylidiaceae). pp. 805-812.

Degtjareva, G.V., Casper, S.J., Hellwig, F.H., Schmidt, A.R., Steiger, J. and Sokoloff, D.D.: Morphology and nrITS phylogeny of the genus *Pinguicula* L. (Lentibulariaceae), with special attention to embryo evolution. pp. 778-790.

Ellison, A.M.: Nutrient limitation and stoichiometry of carnivorous plants. pp. 740-747.

Gebühr, C., Pohlon, E., Schmidt, A.R. and Küsel, K.: Development of microalgae communities in the phytotelmata of allochthonous populations of *Sarracenia purpurea* (Sarraceniaceae). pp. 849-860.

Gorb, E.V. and Gorb, S.N.: Physicochemical properties of functional surfaces in pitchers of the carnivorous plant *Nepenthes alata* Blanco (Nepenthaceae). pp. 841-848.

Greilhuber, J., Borsch, T., Müller, K., Worberg, A., Porembski, S. and Barthlott, W.: Smallest

angiosperm genomes found in Lentibulariaceae, with chromosomes of bacterial size. pp. 770-777.

Heubl, G., Bringmann, G. and Meimberg, H.: Molecular phylogeny and character evolution of carnivorous plant families in Caryophyllales—revisited. pp. 821-830.

Hobbhahn, N., Küchmeister, H. and Porembski, S.: Pollination biology of mass flowering terrestrial *Utricularia* species (Lentibulariaceae) in the Indian Western Ghats. pp. 791-804.

Laakkonen, L., Jobson, R.W. and Albert, V.A.: A new model for the evolution of carnivory in the bladderwort plant *(Utricularia)*: adaptive changes in cytochrome *c* oxidase (COX) provide respiratory power. pp. 758-764.

Meimberg, H. and Heubl, G.: Introduction of a nuclear marker for phylogenetic analysis of Nepenthaceae. pp. 831-840.

Müller, K.F., Borsch, T., Legendre, L., Porembski, S. and Barthlott, W.: Recent progress in understanding the evolution of carnivorous Lentibulariaceae (Lamiales). pp. 748-757.

Plachno, B.J., Adamec, L., Lichtscheidl, I.K., Peroutka, M., Adlassnig, W. and Vrba, J.: Fluorescence labelling of phosphatase activity in digestive glands of carnivorous plants. pp. 813-820.

Yadav, S.R., Sardesai, M.M. & Gaikwad, S.P. 2005. A New Species of *Utricularia* L. (Lentibulariaceae) from the Western Ghats, India. Rheedea 15: 71-73.

Utricularia babui described in this paper is compared by the authors with *U. graminifolia*. This is somewhat misleading as its closest (and possibly even conspecific) relative is more probably the (usually) larger *U. delphinioides* with almost identical seeds, traps and flowers (if shape and not size is compared). Talking about size it should be noted that a smaller form, *U. delphinioides* f. *minor* was described by Pellegrin already in 1920. Monographer P.Taylor (Kew Bull. Add. Ser. XIV, 1989) considered this form to be connected to the larger, more typical plants by "a continuous range of size". (JS)

Yesson, C. and Culham, A. 2006. Phyloclimatic modeling: Combining phylogenetics and bioclimatic modeling. Systematic Biology. 55: 785-802.

The authors used a novel approach to examine the timing of some speciation events within the *Droseraceae* (*Aldrovanda vesiculosa*, *Dionaea muscipula* and 44 species of *Drosera*). They reanalyzed available molecular sequences using heuristic (educated guess) and Bayesian (likelihood) approaches which yielded an almost identical estimated evolutionary relationship (phylogeny) to Rivadavia *et al.* (2003). Chronograms were produced from phylograms by fixing dates from the fossil record and estimating the rate of speciation by using a likelihood method. Replicate analysis was used to determine confidence levels in the dates indicated for speciation events. Ten climatic parameters were determined for all species examined and mapped onto the chronogram. This account thereby tested how the climatic preferences that could have influenced speciation had changed over time. The results suggested that co-evolution of guilds of species had occurred in response to climate change, particularly the onset of Mediterranean climates in southern Africa and Australia about 15 to 10 million years ago. Palaeoclimatic maps produced indicate how the distribution of optimum climatic conditions changed over time within some *Drosera* lineages.

The approach used is innovative but seems coarse due to limitations of palaeoclimatic data and in the models themselves. The representation of climatic data for wide-ranging and variable species appears overly simplistic (e.g. average daily rainfall for seasonally active species or aquatic species). Geological data is not used, which detracts from the results, e.g. constraining the evolution of *D. neocaledonica*. No new sequence data was presented here. Four uncited references (page 795) hinder background reading. Yet overall this appears to be an exciting approach, one that I suspected will become widely used, and more refined over time. (Robert Gibson)

New Cultivars

Keywords: cultivar: *Dionaea muscipula* 'Petite Dragon', *Sarracenia flava* 'Suspicion', *Sarracenia alata* 'Night.

Dionaea muscipula 'Petite Dragon'

Submitted: 16 February 2006

While visiting California Carnivores in 1999, Peter D'Amato gave me a small offshoot from a plant labeled *Dionaea* 'Red Dragon' (also known as *Dionaea* 'Akai Ryu'). Although I had been growing flytraps since 1955, this was my first *Dionaea* cultivar. Over the subsequent six years, the plant divided numerous times and now I have many individual plants of that clone.

Since my initial introduction to *Dionaea* cultivars, I have developed a hobby of comparing cultivars under similar growing conditions, including *Dionaea* 'Akai Ryu.' It soon became apparent that the plant that I received from Peter was not the true *Dionaea* 'Akai Ryu.' In fact, the plant was so different that on February 9, 2006 I decided it should be given a cultivar name, and selected the name *Dionaea* 'Petite Dragon'. Whereas *Dionaea* 'Akai Ryu' is described in Carnivorous Plant Newsletter 25(2):50 as "far superior to any of the parents in terms of growth rate and vigor," and that "growth habit and flower morphology are typical for this species," *Dionaea* 'Petite Dragon' remains the smallest plant (even as a 6-year-old flowering adult) of any flytrap that I have grown in 50 years. Grown outside in full sun, a mature *Dionaea* 'Petite Dragon' trap is typically 15 mm long, with the largest attaining 17 mm (see Figure 1). The rosette diameter of mature plants is about 6 cm and rarely exceeds 10 cm in spring. The flower scape is about 12 cm tall and always bifurcates into two flower clusters, a large and small one (see Figure 2). The flowers have a red stigma. This is the only clone of the 61 "named" clones (i.e. plants with cultivar names, or other informal grower-given appellations) that I presently grow in which the flower scape bifurcates regularly. I have selfed this plant over several years and all of the offspring grow into small adults having bifurcated flower scapes. This plant and its seed offspring are all red like *Dionaea* 'Akai Ryu', and the stigma is red as in many other all-red *Dionaea* clones.

This plant will principally be of interest to those that study the genetic diversity of *Dionaea muscipula*. Those that seek giant specimens will perhaps conclude that *Dionaea* 'Petite Dragon,' to quote a well-known critic, "only merits the trash can because it is a crappy grower." However, some growers may be interested in miniature rather than giant flytraps.

Etymology: This clone is herein described as *Dionaea muscipula* 'Petite Dragon,' because it suggests a small *Dionaea* 'Akai Ryu.'

Although the plant produces fertile seed when selfed and all of the seedlings are red like the parent and the offspring retain this double scape, the preferred method of propagating it is by vegetative means to preserve the genetic integrity.

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Sarracenia flava 'Suspicion'

Submitted: 9 February 2007

At first glance, *Sarracenia* 'Suspicion' (see Front Cover) may appear to be a clone of *Sarracenia flava* var. *maxima*. On closer inspection the plant is revealed to be in fact an antho-

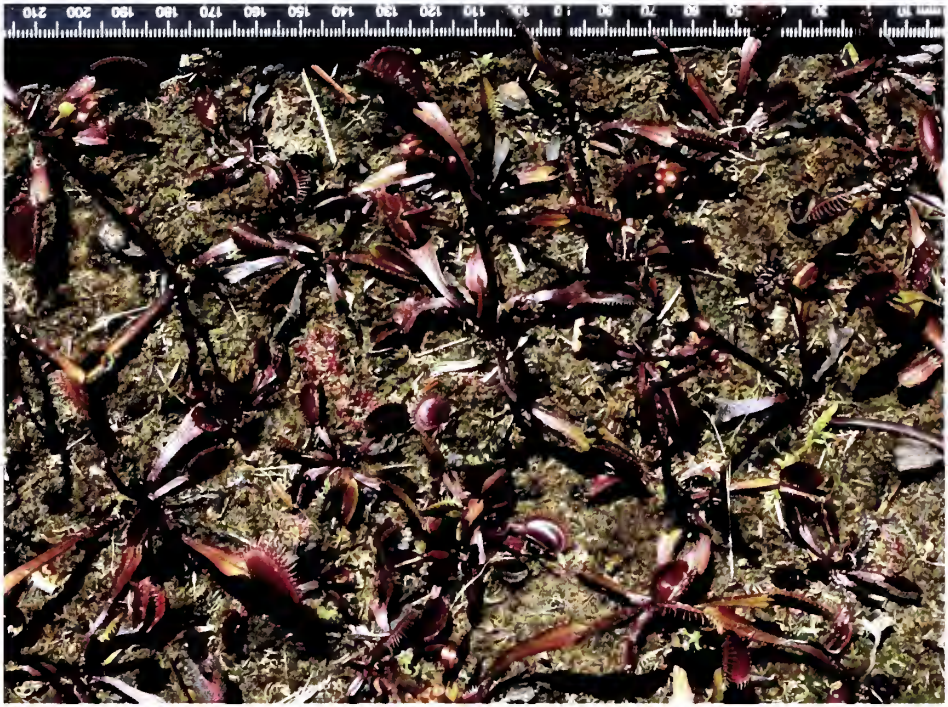

Figure 1: *Dionaea muscipula* 'Petite Dragon' growing outdoors in an artificial bog—spring rosettes are 6 cm in diameter.

Figure 2: *Dionaea muscipula* 'Petite Dragon': bifurcated flower scapes in spring before greenhouse-grown plants have attained full red coloration (left), and flowers with red stigmas (right)

cyanin-free *Sarracenia flava* clone that is wholly devoid of any anthocyanin induced red colouration, even when grown under conditions of intense, direct sunshine. There is no red colouration evident in any parts of the plant, including cladophylls and rhizome. Nor does the plant display spots of red discolouration when damaged, as is normally the case in *Sarracenia*.

The slim and elegant pitchers are a bright, apple green when fresh, slowly fading to a lemon yellow by the end of the growing season. The sulphur-yellow flower with the usual musty perfume is entirely typical for the species.

Resulting from the self-pollination of a *Sarracenia flava* clone acquired from Adrian Slack, *Sarracenia* 'Suspicion' was raised from seed in 1989 by UK grower Stephen Locke. Unlike some anthocyanin-free *Sarracenia* variants, *Sarracenia* 'Suspicion' has proved to be quite vigorous in cultivation.

The derivation of the name *Sarracenia* 'Suspicion' is as an allusion to envy, which is often signified by the colour green. The cultivar name was coined on February 8th, 2007.

In order to maintain the unique characteristics of the plant, reproduction must be achieved by vegetative methods only.

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Sarracenia alata 'Night'

Submitted: 1 June 2006

This plant was selected as the best plant from a large batch of seedlings. The seed source was the ICPS seed bank and the reported collection location was "Stone County, Mississippi." The seedlings were raised at the Botanical Conservatory at the University of California, Davis by John Brittnacher, and accessioned into the collection in 2002. Other seedlings from this batch of seeds were also impressively red-colored *S. alata*.

Sarracenia alata 'Night' is a tall and vigorous clone (see Figure 3). At the time of description (and photograph), the tallest pitcher was 74 cm high (29"), which makes it the tallest of the *S. alata* plants at the Botanical Conservatory at the University of California, Davis. The underside of the hood and pitcher throat are effectively black in mature pitchers, and the exterior of the upper third of the pitcher tube is deep red. This clone produces copious amounts of nectar on the pitcher column, and in sunlight the droplets sparkle against the black throat giving the impression of stars twinkling in the night sky, which provided the inspiration for the cultivar name. I coined the cultivar name in April, 2006.

This clone has other interesting features as well. The base of the pitcher is blood red, and the top side of the hood is red and yellow with pronounced red venation. The contrast between the reticulated red venation is far greater than the upper pitcher. The pitcher tube constricts just below the mouth of the pitcher.

The entire time we have grown this plant, the pitcher coloration of the pitchers has been stable. Young pitchers start as a light lime-green with red venation. The coloration spreads from the veins to the webbing of the pitcher as the pitcher matures, until the overall red color is achieved. The pitchers become dark red, and the throats blacken, about 2-3 weeks after the pitchers open. As with many red-colored *Sarracenia*, this plant requires high light levels and high humidity to develop and maintain the red coloration. Small plants (<7.5cm high) do not develop the deep red colors but the venation is redder and more pronounced than typical *S. alata* plants.

The flowers of this clone are typical for *S. alata*, which confirms that this plant has not achieved its exceptional coloration through hybridization or introgression. The petals are cream colored and rounded. The sepals are light cream to yellow.

The rhizome readily forms lateral branches, which aids in propagation. This clone should only be propagated by vegetative means to maintain both the details of the dark red and black coloration on the pitchers and the high vigor of this selection.

Figure 3: *Sarracenia* 'Night' The plant pictured was grown in a very bright greenhouse in Davis, CA.

The nomenclature of the red forms of *S. alata* is rather vague. Don Schnell (2002) mentions red *S. alata* plants, but he does not establish a name for them at the variety or from rank. Peter D'Amato (1998) mentions plants, using the descriptor "nigrapurpurea," to indicate specimens that have dark red or nearly black pitcher lid undersides. This term should be avoided since it has never been formally described, but the characteristics of *S. alata* 'Night' would appear to be similar, if not identical.

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Prey preference in two species of North American bladderworts (*Utricularia*) suitable for water gardens

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Keywords: carnivory: prey, *Utricularia*.

Introduction

Carnivorous plants almost always attract significant attention (D'Amato 1998), and since many of them are attractive because of bright red and green foliage plus a range of flower colors, water gardeners may wish to use these plants in their ponds or along their pond margins.

One concern that might arise from the use of carnivorous plants in the water garden is the possibility of their affecting other parts of the garden. While most carnivorous plants are not weedy, and few of them would be capable of puncturing a pond liner, some of the aquatic carnivorous plants might capture young fish or other small creatures in water gardens, disturbing the ponds' ecology. If a water gardener breeds valuable fish, trapping of their fry by the plants would be especially problematic. Since such carnivorous plants, which include both the waterwheel plant (*Aldrovanda vesiculosa*; Droseraceae) and aquatic bladderworts (*Utricularia* spp.; Lentibulariaceae), are some of the easiest to cultivate in water gardens, it is important to determine what effects they might actually have on young fish and other small animals.

Prey preference is the selection of particular species of prey. While one author's (DWD) laboratory has previously dealt with prey preference in *A. vesiculosa* (Chadwick & Darnowski 2002), this paper describes experiments designed to test the prey preferences of two aquatic bladderworts, *U. gibba* (the mud bladderwort) and *U. foliosa* (foliose bladderwort).

Utricularia gibba, composed of thin filaments of cells bearing rounded suction traps and yellow flowers, is the most widely ranging bladderwort in the world; native to six continents, it grows readily in a wide range of environments from the oligotrophic waters favored by most aquatic carnivorous plants to truly eutrophic waters as are found in most lily ponds. *Utricularia foliosa* (Figure 1) grows very well under this wide range of conditions as well, but it is much more robust and bears 10-100 times as many traps per unit length of the main stem (Darnowski, pers. obs.). It also has yellow flowers and is native to the southeastern US (Schnell 2002).

Materials and Methods

Plants of *U. gibba* from an existing laboratory culture were grown in aquaria which received both light from a south-facing window and constant supplemental fluorescent lighting. Plants of *U. foliosa* were obtained from Lee's Botanical Gardens (Florida, USA; www.lbg-cp.com) and cultured as for *U. gibba* until use.

Experimental protists and crustaceans, both unicellular (*e.g. Blepharisma* sp.) and multicellular (*e.g. Volvox* sp.), were obtained from Carolina Biological Supply (Burlington, North Carolina, USA) and either used immediately or cultured until used. Small fish (*Poecilia reticulata*, syn. *Lebistes reticulata*) were obtained from local pet stores and kept in tanks as per *U. gibba* and *U. foliosa*, but not with those plants. These guppies bred, and the immature fish, approximately 0.5 cm long and 1-2 mm in diameter, were used for experiments. All culture containers were 4.1 cm × 4.1 cm × 7.3 cm tall clear plastic boxes. Each container was filled with 20 ml of pond water to provide a medium amenable for the plants and other organisms. The water was filtered through Whatman #1 filter paper to remove any protists or small animals which

might confound the results of the experiments below.

Three experiments were performed to determine the effects of these aquatic carnivorous plants on protists and small animals which might be found in cultivated ponds. In the first experiment, prey were offered to either five pieces of *U. gibba* each approximately 15 cm long or to one apical piece of *U foliosa* approximately 8 cm long. These prey represented three size categories: 1)small (rotifers, microscopic animals; water bears, a different type of microscopic animals; *Volvox*, a microscopic multicellular green alga; *Stentor*, a large unicellular protist; and *Arcella*, a type of amoeba), 2)medium (copepods, ostracods, amphipods, and *Daphnia*, all small crustaceans easily visible to the naked eye; and *Hydra*, a multicelluar animal approximately 1 mm tall), and 3)large, i.e. white cloud mountain minnow fry (*Tanichthys albonubes*), ghost shrimp (*Thalassinidea callianassidae*), and fairy shrimp (*Artemia* sp.). Prey were tested within their size group—*i.e.* all of the small prey listed above were offered in one container, all of the medium sized ones in another, etc. After one week, traps were examined using a dissecting microscope.

Based on this first set of experiments, prey which were trapped never or almost never (all large prey above, *Daphnia*, *Stentor*, *Arcella*) were eliminated from further work on prey preference. In the second experiment, the remaining eight types of prey were provided to bladderworts again, but mixed together. The relative numbers of prey types in the prey mixture are shown in column two of Table 1. Enough of this mix was added in each repetition so that approximately ten of the rarest prey type (i.e. amphipods, copepods, ostracods) were offered in each repetition. The results of trapping were tabulated after one week.

In the third experiment, because of the particular relevance of young fish being trapped for water gardening enthusiasts, young fish were exposed to bladderworts, with the bladderworts being provided in greater density than previously, i.e. ten pieces of *U. gibba* or five of *U. foliosa*. Young guppies were used instead of white cloud mountain minnows because of their easier availability. After one week, each container was examined to determine whether the fish was alive, and if not, how it had died.

Results

In the second experiments in which bladderworts were offered a mixture of possible prey (Table 1), the most commonly caught organisms were rotifers and the single-celled green alga *Chlamydomonas*, which were trapped in far greater numbers than other equally abundant prey organisms. Most other prey offered were rarely if ever trapped.

In the third experiment in which young fish were offered to bladderworts, the fish were very frequently killed during the week. Four of the six young guppies offered to *U. gibba* were captured, while only one of the six young guppies offered to *U. foliosa* were captured. Examination

Prey type	Relative Abundance	Percentage Trapped	
		U. foliosa	*U. gibba*
Rotifers	100	2%	2%
Water Bears	10	0%	60%
Chlamydomonas sp.	1000	2%	0.5%
Blepharisma sp.	100	100%	0.3%
Volvox sp.	100	2%	2%
Amphipods	1	0%	0%
Copepods	1	0%	0%
Ostracods	1	0%	0%

Table 1: Trapping of prey by *Utricularia*

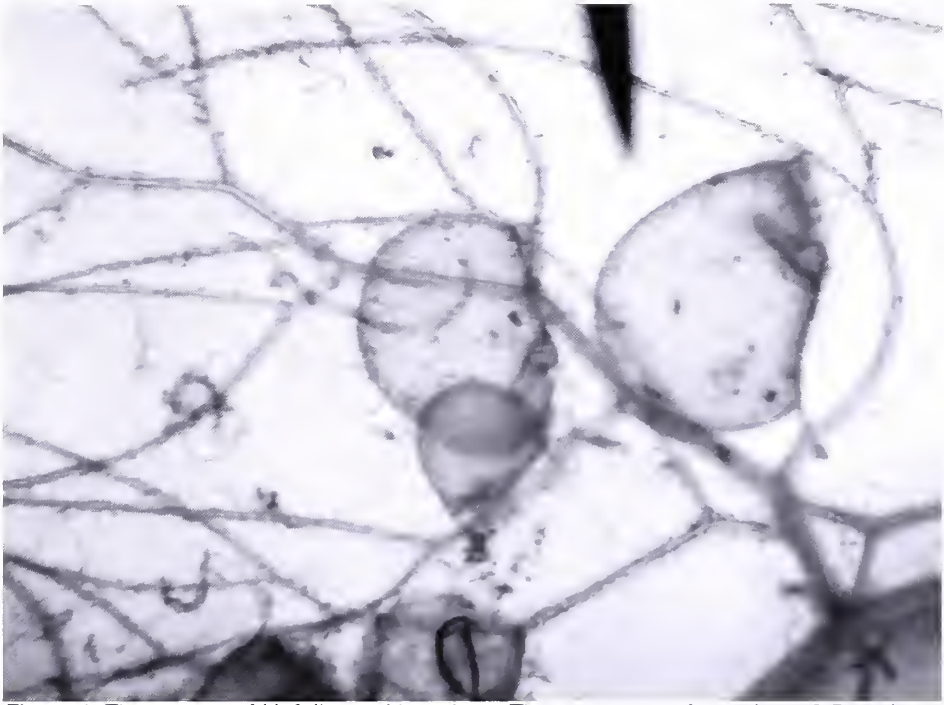

Figure 1: Three traps of *U. foliosa* with stolons. The traps range from about 0.5 to about 2 mm long. The black pointer points to a bladder. Photograph by Andrew Koerber.

Figure 2: Baby killifish, of very similar size and behavior to a baby guppy, trapped by *U. radiata*, with traps of very similar size and arrangement to *U. foliosa*. This type of trapping, by the head, was less common than trapping of a fin. Photograph by Douglas Darnowski.

of the cultures usually showed the dead fish with its tail trapped in a bladderwort trap which was either still attached to the plant or which had fallen from the plant (Figure 2).

Discussion

These experiments were undertaken to examine the role that bladderworts might play in a pond—given a range of prey, which ones are preferentially trapped by these carnivorous plants? This study complements earlier investigations on the abiotic preferences (light, $[CO_2]$, presence of various metal ions) of aquatic *Utricularia* (McDermott & Darnowski 2002; Saha & Darnowski 2005).

The most striking result is that whether prey was provided individually or in mixes, there are clear preferences for certain prey types. This agrees with previous findings in the genus *Utricularia* and in *Aldrovanda vesiculosa* (Harms & Johansson 2000; Chadwick & Darnowski 2002). Both of those studies found that the behavior of prey resulted in prey selection by aquatic carnivorous plants. For example, in *A. vesiculosa*, prey which frequently moved about among plants and which also rested on the plants were often caught, probably due to their greater time near the traps and therefore the greater probability that they would encounter the traps' trigger hairs.

In our experiments, trapping frequency varied between species for a given type of prey. For example, water bears were caught by *U. gibba* but not by *U. foliosa*, perhaps due to the differences in their behavior. Rotifers were moved more actively in this experiment than waterbears, so perhaps they were caught by both species due to collisions with traps' trigger hairs. In contrast, the more lethargic waterbears may have some behaviors which lead to their trapping by *U. gibba* but not by *U. foliosa*—this needs further testing, perhaps using time lapse video microscopy to track waterbear behavior. Perhaps waterbears prefer to rest on the less densely packed stems of *U. gibba* compared to those of *U. foliosa* and are thus much more likely to be near the traps of *U. gibba*, leading to their being trapped.

Other results may be similarly explained by the behavior of prey species. For example, *Chlamydomonas* sp., probably too small to trigger the traps by themselves, may be caught accidentally along with other, larger prey. The low frequency of trapping for crustaceans may be due to the relatively large size of the individuals offered to plants in this work. In future, offering of juvenile individuals might lead to different results.

There were differences between the two types of bladderwort tested, most surprisingly that the species with far more traps per unit length, *U. foliosa*, trapped fewer prey. It has been suggested that the traps of *U. purpurea* may function as aquaria in which mutualistic organisms grow, rather than as carnivorous organs (Richards 2001). *Utricularia purpurea* is in a different taxonomic section of *Utricularia* from *U. foliosa*, but *U. foliosa* does have smaller trigger hairs than many other bladderworts, somewhat like *U. purpurea* (Taylor 1989). If the hypothesis regarding *U. purpurea* is true, perhaps *U. foliosa* shares this trait to a more limited extent.

From this work, one recommendation for water gardeners is that aquatic carnivorous plants are probably a safe addition to the ecology of their ponds, so long as the bladderworts do not dominate other forms of vegetation. Given that this generally does not occur in natural sites where bladderworts and waterlilies occur (Darnowski, pers. obs. in USA and Australia), these plants should make an interesting addition to home ponds.

One caveat is that for those seeking to breed fish, it may be necessary to provide either an entirely separate habitat for breeding or at least separate enclosures within the larger pond. This recommendation comes from the finding that small fish in areas in which bladderworts grew densely were frequently trapped. One author (DWD) has noted in his own pond that the areas of most dense growth provide a suitable substrate on which fish lay their eggs, so preventing contact between the plants and breeding fish, their eggs, and/or their fry may be important if aquatic carnivorous plants are to be kept in waterlily ponds in which fish are bred.

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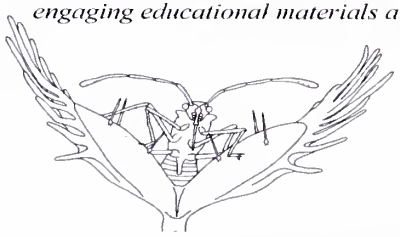

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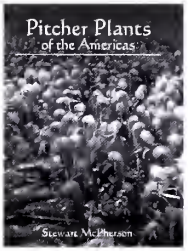
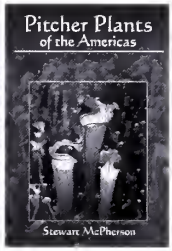
Book Review





McPherson, Stewart. 2006. Pitcher Plants of the Americas. The McDonald & Woodward Publishing Company, Blacksburg, Virginia. ISBN-13: 978-0-939923-74-8, 320 p., approximately 245 color photographs, figures and maps. Hardcover, 16.5 × 23.5 cm (6.5 × 9.25 in), hardcover price US$44.95, softcover price $34.95, shipping extra.

Reviewed by Barry Rice

Stewart McPherson loves carnivorous plants, and it shows!

His quest is to write a set of five books that will treat all the carnivorous plants. These will be released one at a time, Harry Potter style. Will he be able to complete this great task? I hope so, because his first book in the series is a pleasure to read.

This first volume focuses upon the pitcher plants of North, Central, and South America and the Caribbean. McPherson includes the three genera you might expect (*Darlingtonia*, *Heliamphora*, *Sarracenia*), but also chose to cover three bromeliad species: *Catopsis berteroniana*, *Brocchinia reducta*, and *B. hechtioides*. It is an interesting choice, and McPherson acknowledges that some of these species (most particularly *Catopsis berteroniana*) are not necessarily true carnivores. But we live in a world where research is showing that the lines that previously delineated the carnivorous species are perhaps a little blurry, or at least wiggly. Accordingly, McPherson welcomed these possibly-but-not-necessarily carnivorous species into his work. (*Paepalanthus bromelioides* was not included, the as-yet flimsy evidence for carnivory was apparently too weak to interest McPherson.)

The book is factually strong yet engaging. Its core consists of ten chapters, five of which are the obligatory chapters devoted to plant carnivory, carnivorous plant evolution, conservation, cultivation, and so forth. These are handled well, and any criticisms against them would be minor and essentially irrelevant. The speculative ruminations on evolution and dispersal of pitcher plants are particularly intriguing.

The five genus chapters all share the same structure. Each starts with the material that you would expect—a bit of history, ecology, trapping methodology, range, and the like. Next follows a species by species treatment. There are no surprises on this count, McPherson treats the genera admirably. I found his two chapters on (dare I call them carnivorous?) bromeliads particularly valuable since they are so rarely treated properly.

I value high quality photography, and McPherson's work is really fine. Yes, his close-up work is good, but he also has a superb eye for composition and his landscape photography is truly poster-worthy.

As I mentioned at the start of this review, passion runs deep in this book. You can tell right at the beginning, when McPherson dedicates the book to Sir David Attenborough, whose legacy of decades of extraordinary video explorations (including "The Private Life of Plants", 1995) has drawn so many into the thrall of our natural world. One indicator of this passion is that McPherson clearly wants to document all the diversity he can in his work. So when treating *Sarracenia leucophylla* (which is a species with no described subspecies, varieties, or forms), McPherson discusses eight different "variants." And for *Sarracenia alata*? Ten variants! My only complaint about this is that McPherson uses cultivar format to indicate these variants (i.e. single quotes, and mixed case).

Something else that we must sadly bear in mind is that McPherson's *Sarracenia* range maps are no longer realistic. His maps indicate the overall range of where plants might have occurred at the time of European contact with the New World. But, because of human landscape desecration, *Sarracenia* species occur in only a small fraction of their original sites. A truer presentation of the current extent of *Sarracenia* would be a sparse scattering of dots within the ranges

McPherson illustrates. So you can cross out that *S. oreophila* dot in central Georgia; similarly the great swaths of territory that McPherson shows as range for *S. purpurea* should instead be replaced by widely separated occurrence points. Such is our modern world.

So how does McPherson's book compare with other works? Perhaps the most natural comparison is to Don Schnell's "Carnivorous plants of the United States and Canada" (2002). McPherson's book is not as thick on the science side, nor does it have the depth of perspective gained from as many years of experience as Schnell has. However, it has an obviously different taxonomic scope and overall better photography. McPherson measures up well, even against a high standard.

My pocket assessment is simple: buy this book if you can at all afford it, otherwise I guarantee that some day, when it eventually goes out of print, you will be kicking yourself.

Interested buyers can buy books from http://www.redfernnaturalhistory.com/ or http://www.mwpubco.com/PitcherPlants.htm. A variety of purchasing options are available, including autographed copies. If you buy your copy through Redfern Natural History you will pay a little more, but McPherson has generously pledged that the lion's share of the profits from copies sold through Redfern Natural History Productions will be dedicated to conservation causes, specifically it will be donated to Meadowview Biological Station to support their conservation work in Virginia. Perhaps sales from this book will help improve the appearance of range maps in the future.

News and Views

Barry Rice (barry@carnivorousplants.org) writes: If you haven't heard, conservation workers in North Carolina are trying a new method of deterring poaching of Venus flytraps (*Dionaea muscipula*). Portions of the plants are being painted with a dye that is absorbed into the plant. This dye fluoresces under ultraviolet light, so agricultural inspectors will be able to instantly determine if plants being sold as "propagated" are actually poached. Presumably, this compound is harmless to the plant or other organisms, and presumably it resides in the plant tissues for a long time without decomposing, and presumably it can be applied with minimal mechanical disturbance to the plant. Obviously, it would be impractical to apply this compound to every plant in the wild, but if even a small percentage of plants were treated it could be an effective deterrent for poachers. Plants at two sites managed by The Nature Conservancy (Boiling Springs Lake Preserve and The Green Swamp Preserve) are being painted, and this method is probably be used elsewhere as well. While the protocol may at first glance seem impractical, it has been effective at busting poachers of wild ginseng (*Panax quinquefolius*) in the Smoky Mountains.

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